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ABSTRACT

This guide provides information to enable coordinators to direct learning activities for students using an individualized study guide on operating a drill press. The study material is designed for students enrolled in cooperative part-time training and employed, or desiring to be employed, as drill press operators. Contents include a sample progress chart, suggested teaching procedures for the coordinators, answers to assignment sheets, answers to a unit test, a sheet with the study guide objective and specific objectives, five information sheets, seven assignment sheets, eight transparency masters, and a five-part unit test (each part covers one information sheet). The information sheets cover these topics: preparing to operate a drill press, cutting speeds and cutting fluids, twist drills and drilling accessories, drilling operations, and basic hand and power tools. (YLB)

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ED240370

Individualized Study Guide

GENERAL METAL TRADES

DRILL PRESS OPERATOR

Coordinator's Guide

Prepared by James W. Dean

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DRILL PRESS OPERATOR

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FOREWORD

This individualized study guide has been developed for the student who is enrolled in Cooperative Part-time Training and who is employed or desires to be employed as a drill press operator. The study material is designed to provide the student with general information for immediate reinforcement on the job and to develop an understanding of the job prior to employment.

Even though these study guides are individualized, the coordinator should closely supervise each student's studies. To allow the coordinator to better direct the learning activities, both coordinator guides and student manuals are available. A progress chart provided in each student manual will allow the coordinator to pinpoint the progress a student has made toward each objective in the sequence in which they are completed.

Appreciation is expressed to those whose expertise made possible the development of these study guides. The assistance of these instructors in the development process assures that the materials are current of use to vocational teachers in Texas. The following instructors provided valuable assistance in the developmental process:

Fred Aikin	Mt. Pleasant High School	Mt. Pleasant, TX
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D. G. Gober	Monahans High School	Monahans, TX
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Special credit must be given to James Dean, Assistant Professor of Agricultural Engineering at New Mexico State University who, as a Graduate Assistant with the Occupational Curriculum Laboratory, had primary responsibility for the development of this material. Mention should also be made of the support staff of the OCL who contribute so much to the development of each publication.

Bill Barnes, PhD., Director
Occupational Curriculum Laboratory

DRILL PRESS OPERATOR

Name _____

School _____

Date
Completed

INFORMATION SHEET 1	PREPARING TO OPERATE A DRILL PRESS	
ASSIGNMENT SHEET 1	IDENTIFY DRILL PRESS TERMS	
ASSIGNMENT SHEET 2	EXPLAIN DRILL PRESS SAFETY	
Test	Part 1	
OBJECTIVE	Identify terms, types of drill presses, and parts of a drill press involved in the drilling process.	
INFORMATION SHEET 2	CUTTING SPEEDS AND CUTTING FLUIDS	
ASSIGNMENT SHEET 3	IDENTIFY FEED AND SPEED TERMS	
ASSIGNMENT SHEET 4	SELECTING CUTTING SPEEDS AND FIGURING RPM	
Test	Part 2	
OBJECTIVE	Explain the use of cutting speeds, feeds, and cutting fluids.	
INFORMATION SHEET 3	TWIST DRILLS AND DRILLING ACCESSORIES	
ASSIGNMENT SHEET 5	IDENTIFY THE PARTS OF A DRILL	
ASSIGNMENT SHEET 6	IDENTIFY DRILLING ACCESSORIES	
Test	Part 3	
OBJECTIVE	Identify the parts of the twist drill press and other drilling machines used in industry	
INFORMATION SHEET 4	DRILLING OPERATIONS	
Test	Part 4	
OBJECTIVE	Point out the operations that can be performed on a drill press and other drilling machines used in industry	
INFORMATION SHEET 5	BASIC HAND AND POWER TOOLS	
ASSIGNMENT SHEET 7	BASIC HAND AND POWER TOOLS	
Test	Part 5	
OBJECTIVE	Identify the basic hand and power tools used in drilling operations.	

This student has completed the indicated training under my supervision.

Teacher

DRILL PRESS OPERATOR

SUGGESTED TEACHING PROCEDURES FOR THE COORDINATOR

I. Objective sheet

- A. Discuss each objective with the student.
- B. Explain the relationship of each objective to the student's training station.
- C. Have the student complete the objectives in the most logical sequence for the training station.

(NOTE: A change of sequence is necessary only if a student changes jobs during the year or an employer requests training in a specific area.)

- D. Add any objectives necessary for the training station.

II. Answers to assignment sheets

- A. Some of the assignment sheets will vary according to training and should be graded individually.
- B. Some assignment sheets will not have specifics but will depend on student participation.

III. Answers to the unit test

- A. Answers are based on total information covered in the unit.
- B. For convenience of grading, make corresponding answer sheets for additional test parts added.

IV. Information and corresponding assignment sheets

A. INFORMATION SHEET 1--PREPARING TO OPERATE A DRILL PRESS

- 1. Have the student review the information sheet and then discuss the terms and vocabulary associated with drill presses.
- 2. Use the following assignment sheets to reinforce this area of information:

a. ASSIGNMENT SHEET 1--IDENTIFY DRILL PRESS TERMS

(NOTE: Have the student match the correct drill press terms to the correct definition for that term.)

b. ASSIGNMENT SHEET 2--EXPLAIN DRILL PRESS SAFETY

(NOTE: Have the student discuss the causes of accidents at the training station where assigned.)

3. Have the student's employer explain the operation of the drill press(es) at the training station where assigned.
- B. INFORMATION SHEET 2--CUTTING SPEEDS AND CUTTING FEEDS
1. Have the student review the information sheet and then discuss the following with the student:
 - a. Difference between cutting speed and feed.
 - b. Importance of proper cutting speed and feed.
 - c. How to use the cutting speed table or chart and cutting speed formula.
 - d. The use of cutting fluids.
 2. Use the following assignment sheets to reinforce this area of information:
 - a. ASSIGNMENT SHEET 3--IDENTIFY FEED AND SPEED TERMS
(NOTE: Have the student match the correct feed and speed terms to the correct definition for that term.)
 - b. ASSIGNMENT SHEET 4--SELECTING CUTTING SPEEDS AND FIGURING RPM
(NOTE: Have the students look up the information required to work the problems from the charts or tables provided in the student's manual and solve the problems.)
 3. Have the student's employer show the student where the cutting speed chart or table is located on the drill press(es) at the training station where assigned, and how to use it.
- C. INFORMATION SHEET 3--TWIST DRILLS AND DRILLING ACCESSORIES
1. Have the student review the information sheet and then discuss the following with the student:
 - a. The purpose of each part of the drill.
 - b. The use of the different types of drills.
 - c. Sizes of drills.
 2. Use the following assignment sheets to reinforce this area of information:
 - a. ASSIGNMENT SHEET 5--IDENTIFY THE PARTS OF A DRILL
(NOTE: Have the student identify the parts of the

drill and write the name of the part in the correct blank provided.)

b. ASSIGNMENT SHEET 6--IDENTIFY DRILLING ACCESSORIES

(NOTE: Have the student match the work holding term to the correct definition provided.)

3. Have the student's employer show the student the types of drills and accessories for the drill press(es) at the training station where assigned.
4. Have the student's employer demonstrate the use of various work holding devices used at the training station where assigned.

D. INFORMATION SHEET 4--DRILLING OPERATIONS

1. Have the student review the information sheet and then discuss the following with the student:
 - a. Various operations performed on the drill press.
 - b. Other types of drilling machines used in a production shop.
2. Have the student's employer explain and demonstrate the operations performed on the drill press.

E. INFORMATION SHEET 5--BASIC HAND AND POWER TOOLS

1. Have the student review the information sheet and then discuss the following with the student:
 - a. Use of basic hand and power tools.
 - b. Safety factors in handling and operating hand and power tools.
2. Use ASSIGNMENT SHEET 7--BASIC HAND AND POWER TOOLS to reinforce this area of information.

(NOTE: Have the student identify and make a list of the hand and power tools used by the student at the training station assigned.)

3. Have the student's employer explain and demonstrate the proper and safe use of the hand and power tools used on the job.

V. Transparency masters

(NOTE: Transparencies are provided in the student manuals as information sheets.)

A. TM-1--COMMON SHOP DRILL PRESSES

- B. TM-2--PARTS OF A DRILL PRESS
- C. TM-3--PROPER USE OF THE DRILL PRESS
- D. TM-4--SPEEDS FOR FRACTION-SIZE DRILLS
- E. TM-5--SUGGESTED DRILL SPEEDS
- F. TM-6--PARTS OF A TWIST DRILL
- G. TM-7--OPERATIONS OF THE DRILL PRESS
- H. TM-8--OTHER DRILLING MACHINES

VI. Unit test

- A. The unit test is divided into five parts.

(NOTE: Each part covers one information sheet.)

- B. Various approaches may be used in testing:

1. Each part of the test may be given as the student reviews the information on each information sheet.
2. Give the entire test upon completion of all the information sheets in the unit.
3. Give one or more parts of the test as an additional assignment, or to reinforce areas the student did not understand.

- C. Add test parts corresponding to any information area or sheets added to the unit.

VII. References

- A. A Suggested Basic Course Outline for General Metal Trades Cluster. Occupational Curriculum Laboratory, East Texas State University, Commerce, Texas 75428
- B. Wasiloff, Thomas. Machine Shop Skill Manual. American Technical Society, Chicago, Illinois 60637
- C. Walker, John R. Modern Metalworking. Goodheart-Wilcox, South Holland, Illinois 1976

DRILL PRESS OPERATOR
ANSWERS TO ASSIGNMENTS

Assignment Sheet 1

A. 15	G. 14	M. 13
B. 9	H. 1	N. 5
C. 11	I. 4	O. 7
D. 17	J. 6	P. 8
E. 2	K. 3	Q. 12
F. 16	L. 18	R. 10

Assignment Sheet 2

- A. One can receive serious cuts and scratches, lose fingers, hands, eyes, and other parts of the body.
- B. A brush, because metal chips are sharp and will cause serious cuts.
- C. Safety goggles or face shield.
- D. Never.
- E. You can be caught by moving parts which will pull you into the machine.
- F. Never. Because drills can bind into workpiece and create a "Merry-Go-Round" which can seriously hurt you.
- G. Report all injuries immediately so they can be treated.
- H. One must first turn off the power of the drill press and let it come to a complete stop.
- I. The key will fly out once the power is turned on, causing serious injuries.
- J. It prevents damage to drills and foot injuries should they fall out from the chuck.

Assignment Sheet 3

A. 6	E. 12	I. 1	M. 14
B. 8	F. 9	J. 2	N. 4
C. 3	G. 13	K. 10	
D. 7	H. 5	L. 11	

Assignment Sheet 4

A. 1. 100	B. 1280	E. 1. 458
2. 200	C. 800	2. 357
3. 70	D. 1066	3. 437
4. 80		4. 65
5. 50		5. 306

Assignment Sheet 5

A. Dead center
B. Body clearance
C. Margin
D. Web
E. Axis

F. Shank
G. Tang
H. Drill body
I. Flute
J. Lip

Assignment Sheet 6

A. 5	F. 8
B. 4	G. 3
C. 7	H. 6
D. 9	I. 2
E. 10	J. 1

Assignment Sheet 7

A. 17	G. 6	M. 13
B. 7	H. 2	N. 18
C. 15	I. 3	O. 14
D. 8	J. 5	P. 4
E. 1	K. 11	Q. 12
F. 10	L. 9	R. 16

DRILL PRESS OPERATOR

ANSWERS TO TEST

Part 1

- | | |
|----------------------------------|----------------------|
| 1. a. 5 | 2. a. bench model |
| b. 4 | b. floor model |
| c. 1 | |
| d. 3 | |
| e. 2 | |
| 3. a. Speed adjustment handwheel | g. Base |
| b. Switch | h. Power assembly |
| c. Depth gauge | i. Feed wheel |
| d. Spindle lock clamp | j. Table clamp lever |
| e. Chuck | k. Column |
| f. Table | |

Part 2

- | | |
|---------|------|
| 1. a. 2 | e. 1 |
| b. 3 | f. 3 |
| c. 2 | g. 1 |
| d. 3 | h. 2 |
2. Answer should include three of the following five:
- To cool a drill during drilling so it will not lose its temper.
 - To act as a lubricant to reduce friction at the cutting edge.
 - To reduce the tendency of chips to weld to the cutting lips of the drill bit.
 - To improve the finish of the hole.
 - To wash away chips from the hole.

Part 3

- | | | |
|----------------|-------------------|------------------|
| 1. a. Lip | e. Dead center | i. Axis of drill |
| b. Flute | f. Margin | j. Tang |
| c. Drill body | g. Body clearance | |
| d. Shank | h. Web | |
| 2. a. C-clamp | e. V-block | |
| b. Step block | f. Strap clamp | |
| c. T-slot bolt | g. Angle plate | |
| d. Vise | h. Drill jig | |

Part 4

- | | | | | | |
|----|----|---|----|----|--------------|
| 1. | a. | 5 | 2. | a. | Gang |
| | b. | 1 | | b. | Radial |
| | c. | 3 | | c. | Upright |
| | d. | 4 | | d. | Multispindle |
| | e. | 2 | | | |
| | f. | 7 | | | |
| | g. | 6 | | | |

Part 5

- | | | | |
|----|----------------------------|----|--------------------------|
| a. | Outside micrometer caliper | h. | Scribe |
| b. | Center punch | i. | Pipe cutter |
| c. | File | j. | Die |
| d. | Divider | k. | Hacksaw |
| e. | Tap | l. | Steel pocket tape |
| f. | Prick punch | m. | Steel rule or bench rule |
| g. | Combination square set | | |

DRILL PRESS OPERATOR

STUDY GUIDE OBJECTIVE

Upon completion of this study guide, the student will be able to use the proper terms and understand the safety rules to be observed when performing the various operations required in operating a drill press. The student will also be able to identify the cutting tools and accessories used on the drill press. This knowledge will be evidenced by satisfactorily completing the study guide test.

SPECIFIC OBJECTIVES

After completing this study guide, the student will be able to:

1. Identify terms, types of drill presses, and parts of a drill press involved in the drilling process.
2. Explain the use of cutting speeds, feeds, and cutting fluids.
3. Identify the parts of the twist drill and the accessories used on the drill press.
4. Point out the operations that can be performed on a drill press and other drilling machines used in industry.
5. Identify the basic hand and power tools used in drilling operations.

DRILL PRESS OPERATOR

INFORMATION SHEET 1--PREPARING TO OPERATE A DRILL PRESS

I. Terms and definitions

- A. Drilling--forming a hole with a drill.
- B. Twist drill--a cutting tool with a spiral grooved body, used for cutting holes.
- C. Drill press--a machine used for drilling holes in material. Work is fixed on table or base of machine.
- D. Clamping devices--tools used to fasten workpiece to table.
- E. Operations--jobs performed.

II. Common shop drill presses

- A. Bench model--operated by rotating a cutting tool (drill) against the material with enough pressure to cut and penetrate the material. It is usually mounted on a bench and is smaller than floor-type drill press. Used for smaller jobs.
- B. Floor model--operates on the same principle as bench-type drill press. Used for larger jobs due to larger working area of table movement.

III. Parts of a drill press

- A. Base--supports the machine.
- B. Table--supports workpiece.
- C. Column--supports the table.
- D. Table clamp level--locks table to column.
- E. Chuck--holds or clamps drill in place.
- F. Spindle lock clamp--locks spindle in place.
- G. Depth gauge--measures depth of holes.
- H. Switch--turns power on or off.
- I. Speed adjustment handwheel--control with dial which adjusts cutting speeds.

CAUTION: Turn handwheel only while machine is running.

- J. Step pulley speed control--another method of changing cutting speeds by moving the belt to different pulley ratios.

(NOTE: On most conventional drilling machines it is not possible to set the machine at the exact speed and

I
N
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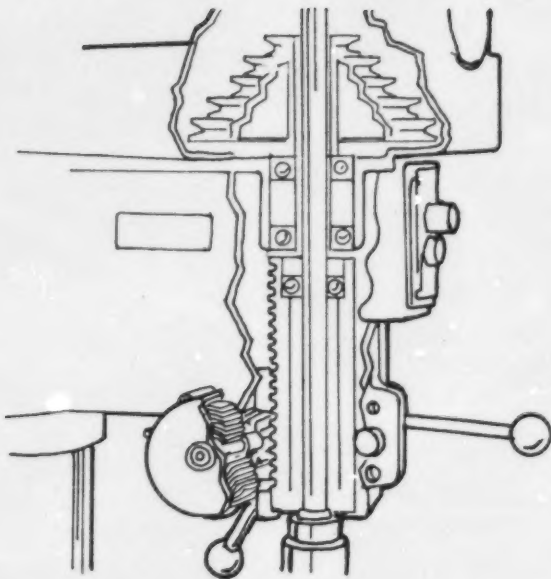


Figure 1

IV. Common adjustments

(NOTE: Size--determined by the distance of the spindle from the column and by capacity of drill chuck.)

- A. Speeds--different RPMs to set for different materials and twist drill sizes.
- B. Twist drills--cutting angles change for different metals.
- C. Work holding devices--positioning clamps, and drill press vises for different operations.
- D. Table--a surface which can slide on column, up or down, and side to side.
- E. Table angles--(some models) position changes to allow circular movement of table in degrees to drill holes at an angle.

V. Safety

- A. Keep your hands away from moving parts.
- B. Protect your eyes from flying chips, wear safety glasses or goggles.
- C. Do not handle metal chips with your hands.

(NOTE: Use a brush to clean chips from the drill.)

- D. Do not wear loose clothes, and keep long hair tied back while operating the drill press.

the operator must settle for a speed nearest the desired RPM. The number of speed settings is limited by the number of pulleys in the drive mechanism. An engraved metal chart showing spindle speeds is usually attached to the machine.) See Figure 1.

- K. Power assembly--the system of electric motor, pulleys, and belts to provide and transmit power needed to operate machine cutting action.

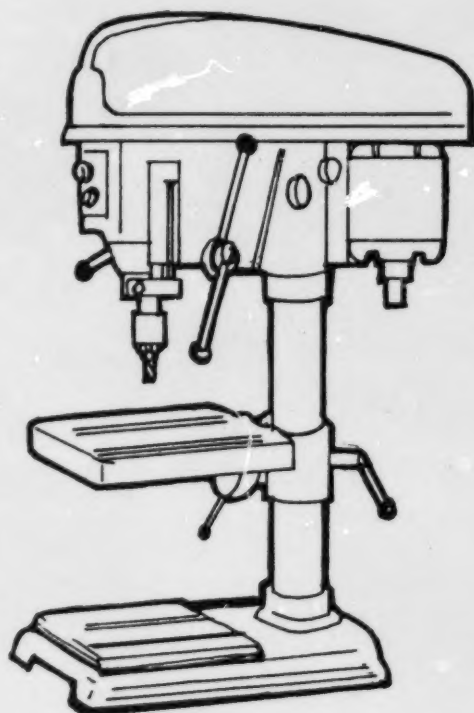
- E. Make sure that machine is in good working order.
- F. Keep drills sharp and clean.
- G. Clamp your work solidly. Do not hold work with hands.
- H. Never attempt to stop machine with your hands.
- I. Stop machine when measuring or making adjustments.
- J. Place a piece of wood over the table when removing drill bits from the drill press to prevent the bits from falling through the holes in the table.

(NOTE: Small drills will be damaged and larger drills can cause foot injuries.)

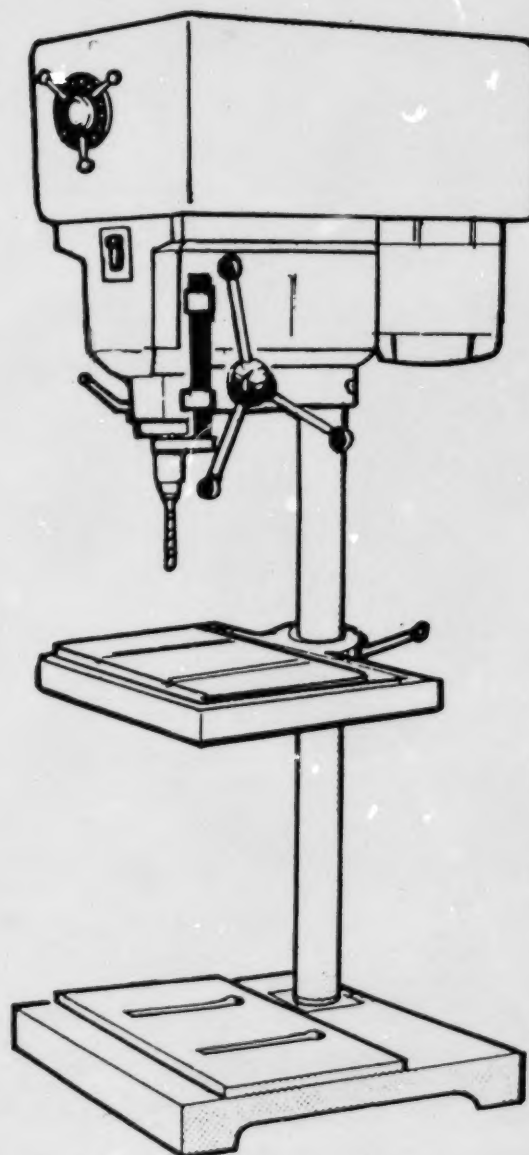
- K. Treat cuts and scratches immediately.
- L. Always remove chuck key from the chuck before turning on the power.
- M. Wipe spilled cutting oil from machine and floor.
- N. Do not misuse the drill press.
- O. Report any damage to the instructor.
- P. Avoid seizing by relieving pressure on the drill just before it breaks through the stock and to prevent it from binding, causing the stock to rotate or the drill to break.
- Q. Before operating machine, make sure all guards are in place.
- R. Support ends of long stock to keep undue pressure from being exerted on the drill.

INFORMATION

COMMON SHOP DRILL PRESSES

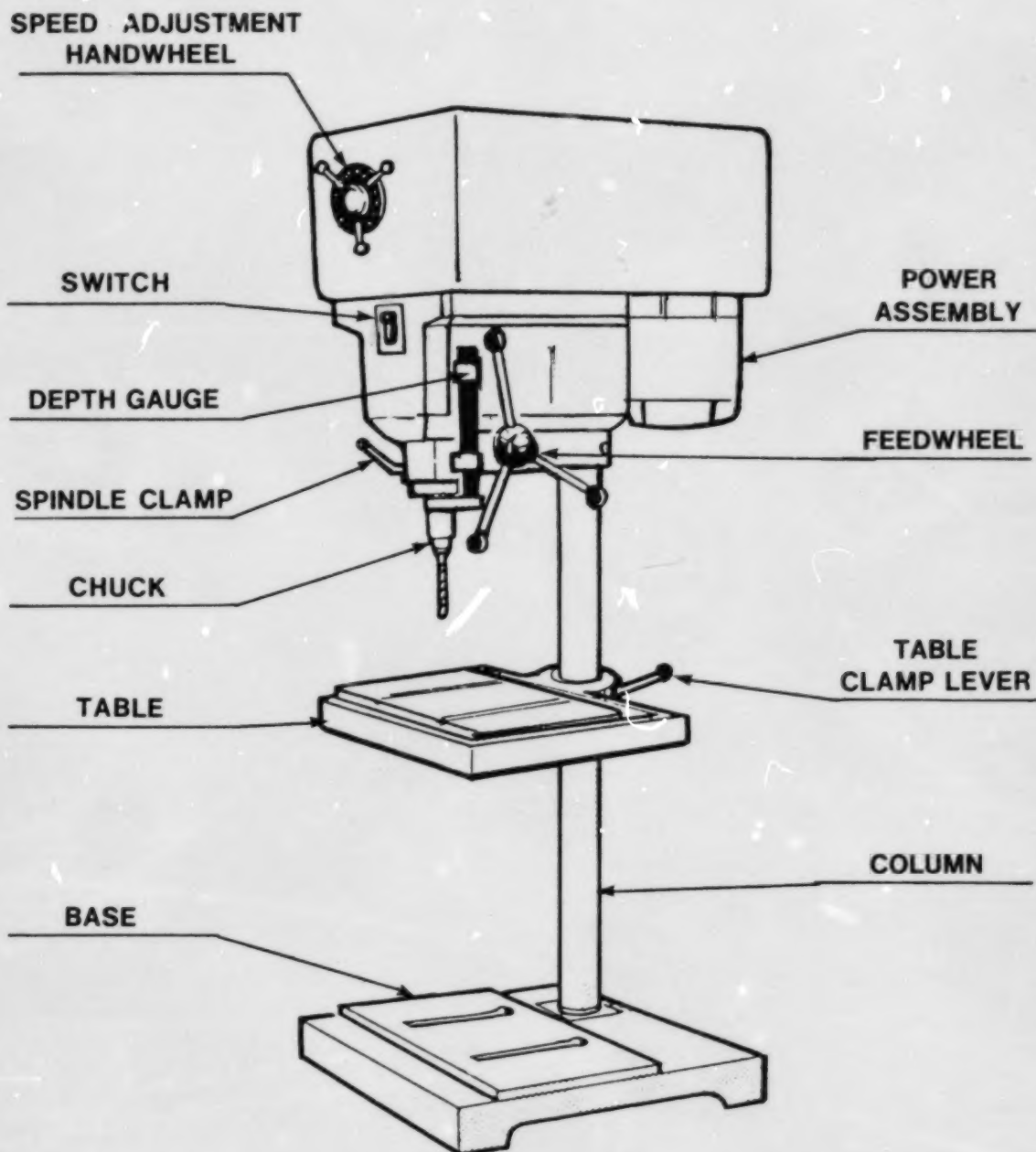


BENCH MODEL



FLOOR MODEL

PARTS of a DRILL PRESS



TM-2

PROPER USE of the DRILL PRESS



TM-3

DRILL PRESS OPERATOR

ASSIGNMENT SHEET 1--IDENTIFY DRILL PRESS TERMS

Directions: Match the correct word or words in the right column to the correct definition in the left column. Place the appropriate number in the space provided on the left.

- | | |
|---|--|
| ___ A. Process of forming a hole with a drill. | 1. base |
| ___ B. A machine used for drilling holes. | 2. twist drill |
| ___ C. Used to fasten workpiece to table. | 3. size |
| ___ D. Jobs performed. | 4. chuck |
| ___ E. Used for cutting holes. | 5. spindle lock clamp |
| ___ F. Drill press which sits on a table. | 6. column |
| ___ G. Drill press which sits on the floor. | 7. speed adjustment handwheel or step pulley speed control |
| ___ H. Supports cutting tool. | 8. power assembly |
| ___ I. Holds or clamps drill in place. | 9. drill press |
| ___ J. Supports table. | 10. table |
| ___ K. Distance from column to center of spindle. | 11. clamping device |
| ___ L. Used to measure hole depth | 12. table clamp lever |
| ___ M. Turns power ON or OFF. | 13. switch |
| ___ N. Locks spindle in place. | 14. floor type |
| ___ O. Used to adjust cutting speeds. | 15. drilling |
| ___ P. Provides necessary power to drill press. | 16. bench drill press |
| ___ Q. Locks table to column. | 17. operations |
| ___ R. Supports workpiece. | 18. depth gauge |

ASSIGNMENT

DRILL PRESS OPERATOR

ASSIGNMENT SHEET 2--EXPLAIN DRILL PRESS SAFETY

Directions: Answer the following questions with specific answers.

- A. What can happen if you are not careful when using a drill press?
- B. What should be used to remove metal chips from the drill press and workpiece? Why?
- C. Why must you protect your eyes when performing a drilling operation?
- D. Should you stop a drill press spindle with your hand? Explain.
- E. Describe what could occur if you wear loose clothes or do not tie back hair when operating a drill press.
- F. Is it all right to hold the workpiece with your hands? Explain.

ASSIGNMENT

- G. What procedure should you follow if you are injured while operating the drill press?
- H. What must you do before measuring or making other adjustments when you are drilling?
- I. Explain the danger of leaving a chuck key in the chuck.
- J. Why is it a good practice to lay a piece of wood on the table when removing a drill from the chuck?

DRILL PRESS OPERATOR

INFORMATION SHEET 2--CUTTING SPEEDS AND CUTTING FLUIDS

I. Cutting speeds and feeds

A. Definitions

1. Cutting speed--The surface speed that the drill rotates.

(NOTE: It is shown in *feet per minute-FPM.*)

2. Feed--The speed at which a cutter is fed into the work with each revolution.

3. RPM--Revolutions Per Minute

(NOTE: Cutting speed and feed determine the time required to drill a hole.)

B. Speed and feed table

1. Provides speed and feed recommendations for various materials.

2. Lists speeds for each drill size under RPM column.

3. Shows feeds for each type of metal.

4. Gives clues to use in checking correct manual feed on drill presses:

- a. Uniform chips--indicate drill is fed correctly.

- b. Chatter or scraping noise--indicate drill is dull, or is too slow.

- c. Chipped cutting edges, broken drills, and drill heating, even with coolant--show feed is too fast.

C. Figuring speeds

1. Simple formula-- $RPM = \frac{4 \times CS}{D}$

2. Abbreviations

- a. RPM--revolutions per minute.

- b. CS--cutting speed.

- c. FPM--feet per minute.

EXAMPLE: Obtain recommended cutting speed for drilling aluminum with 250 FPM cutting speed.

- d. D--diameter of twist drill.

- (1) Convert drill diameter 1/4" to .250 decimal fraction.

(2) Place figures in formula: $RPM = \frac{4 \times CS}{D}$

$$RPM = \frac{4 \times 250}{.250}$$

(3) Calculate:

$$RPM = \frac{4 \times 250}{.250} = \frac{1000}{.250} = 4000 \text{ RPM}$$

II. Cutting fluids

A. Purposes

1. To cool a drill during drilling so it will not lose its temper (hardness) and become dull.
2. To act as a lubricant to reduce friction at the cutting edge.
3. To reduce the tendency of chips to become welded to the lips.
4. To improve finish of holes.
5. To wash away chips from holes.

B. Types of cutting fluids

1. Cutting oil--Petroleum mineral oil base.
2. Emulsifiable oil--Mineral oil and water base.
 - a. is mixed with water.
 - b. has better coolant properties than cutting oils.
 - c. contains rust inhibitors.
3. Other coolants and cutting fluids:
 - a. kerosene--used in cutting aluminum and its alloys.
 - b. compressed air--used when machining cast iron.
 - c. cutting wax--developed for use as cutting compounds to be used with other cutting fluids.

SPEEDS for FRACTION-SIZE DRILL

Feet per Min.	30	40	50	60	70	80	90	100	110	120	130	140	150
Diam. (Inches)	Revolutions per Minute												
1/16	1833	2445	3056	3667	4278	4889	5500	6111	6722	7334	7945	8556	9167
1/8	917	1222	1528	1833	2139	2445	2750	3056	3361	3667	3973	4278	4584
3/16	611	815	1019	1222	1426	1630	1833	2037	2241	2445	2648	2852	3056
1/4	458	611	764	917	1070	1222	1375	1528	1681	1833	1986	2139	2292
5/16	367	489	611	733	856	978	1100	1222	1345	1467	1589	1711	1833
3/8	306	407	509	611	713	815	917	1019	1120	1222	1324	1426	1528
7/16	262	349	437	524	611	698	786	873	960	1048	1135	1222	1310
1/2	229	306	382	458	535	611	688	764	840	917	993	1070	1146
5/8	183	244	306	367	428	489	550	611	672	733	794	856	917
3/4	153	203	255	306	357	407	458	509	560	611	662	713	764
7/8	131	175	218	262	306	349	393	436	480	524	568	611	655
1	115	153	191	229	267	306	344	382	420	458	497	535	573
1 1/8	102	136	170	204	238	272	306	340	373	407	441	475	509
1 1/4	92	122	153	183	214	244	275	306	336	367	397	428	458
1 3/8	83	111	139	167	194	222	250	278	306	333	361	389	417
1 1/2	76	102	127	153	178	204	229	255	280	306	331	357	382
1 5/8	70	94	117	141	165	188	212	235	259	282	306	329	353
1 3/4	65	87	109	131	153	175	196	218	240	262	284	306	327
1 7/8	61	81	102	122	143	163	183	204	224	244	265	285	306
2	57	76	95	115	134	153	172	191	210	229	248	267	287
2 1/4	51	68	85	102	119	136	153	170	187	204	221	238	255
2 1/2	46	61	76	92	107	122	137	153	168	183	199	214	229
2 3/4	42	56	69	83	97	111	125	139	153	167	181	194	208
3	38	51	64	76	89	102	115	127	140	153	166	178	191

*Courtesy of Cleveland Twist Drill Co.

SPEEDS FOR FRACTION-SIZE DRILLS*

SUGGESTED DRILL SPEEDS

SUGGESTED DRILL SPEEDS

Material to be Drilled	Cutting Speed (Surface Feet per minute)
Aluminum and its alloys.....	200-300
Bakelite.....	100-150
Brass and bronze, soft.....	200-300
Carbon, pure(carbide drills).....	70-150
Cast iron, soft.....	100
Cast iron, hard.....	100-150
Magnesium and its alloys.....	250-400
Malleable iron.....	80-90
Nickel and monel.....	40-60
Steel, machinery.....	80-100
Steel, annealed.....	70-80
Steel, tool.....	50-60
Steel, forged.....	50-60
Steel, alloy (300 to 400 Brinell).....	20-30
Steel, stainless, free machining.....	30-40
Steel, stainless, hard.....	30-40
Steel, manganese.....	15

Source: American Machinist. Speeds shown above are for high-speed steel drills. Carbon steel drills should be run at from 40 to 50 per cent of those for high-speed steel drills. These are recommended speeds; the best speed in each case must be based on the specific conditions, material, set-up, etc.

DRILL PRESS OPERATOR

ASSIGNMENT SHEET 3--IDENTIFY FEED AND SPEED TERMS

Directions: Match the correct word or words in the right-hand column to the definition in the left-hand column. Place the correct number in the space provided on the left.

- | | |
|---|-------------------------------|
| ___ A. The surface speed that the drill rotates. | 1. feed |
| ___ B. Provides recommended speed and feed. | 2. cutting fluid |
| ___ C. Uniform metal chips. | 3. chips from proper feed |
| ___ D. Chatter, scraping. | 4. $\frac{4 \times CS}{D}$ |
| ___ E. Revolutions per minute (abbreviation). | 5. RPM formula |
| ___ F. Cutting speed (abbreviation). | 6. cutting speed |
| ___ G. Feed per minute (abbreviation). | 7. caused by dull drill |
| ___ H. $RPM = \frac{4 \times CS}{D}$ | 8. speed and feed table |
| ___ I. The speed with which the drill is moved into the work space. | 9. CS |
| ___ J. Cools and lubricates drills. | 10. kerosene |
| ___ K. Used when cutting aluminum. | 11. compressed air |
| ___ L. Used when cutting cast iron. | 12. RPM |
| ___ M. One function of cutting fluids. | 13. FPM |
| ___ N. RPM formula. | 14. wash chips away from hole |
| | 15. SFM |

ASSIGNMENT

DRILL PRESS OPERATOR

ASSIGNMENT SHEET 4--SELECTING CUTTING SPEEDS AND FIGURING RPM

Directions: Using the cutting speed and speed tables shown in Transparencies 4 and 5, complete the following problems. Use the formula $RPM = \frac{4 \times CS}{D}$ and show your work. Select lower values in tables.

- A. What cutting speed should you use in figuring the RPM when drilling each of the following materials:

CUTTING SPEED

1. Soft cast iron

2. Aluminum

3. Annealed steel

4. Malleable iron

5. Forged carbon steel

- B. Figure RPM that should be used when drilling machinery steel with a 1/4-inch diameter drill bit. Use the RPM formula given in the directions.

- C. Figure the RPM setting for a variable steel drill press if a hole one-inch deep is to be drilled in aluminum alloy. The drill size is 1 inch.

- D. Figure the RPM to be used when drilling in malleable iron with a 3/8-inch drill bit.

HINT: Change the fraction to a decimal before dividing.

A
S
S
I
G
N
M
E
N
T

E. Using the tables, select the RPM setting for each of the following materials when drilling with high-speed drills.

<u>MATERIAL</u>	<u>DRILL SIZE</u>	<u>RPM</u>
1. Stainless	1/4"	
2. Bronze	3/4	
3. Tool steel	7/16"	
4. Steel alloy	1 3/4"	
5. Hard cast iron	7/8"	

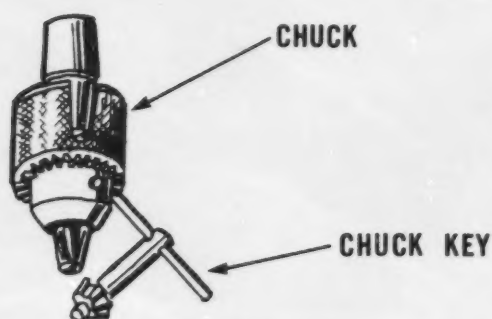
DRILL PRESS OPERATOR

INFORMATION SHEET 3--TWIST DRILLS AND DRILLING ACCESSORIES

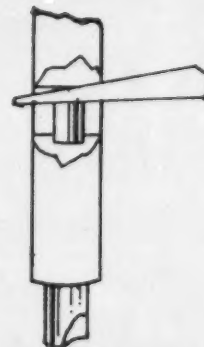
I. Twist drills

A. Parts of a twist drill (TM-5)

1. Point--Cone-shaped end that does the cutting. Consists of:
 - a. Dead center--Sharp edge at the tip of drill. Center of drill.
 - b. Lips--Cutting edges of drill.
 - c. Heel--Portion of the point opposite the cutting edge.
2. Shank--End of drill bit that is attached to the drill press.
 - a. Straight--Used with a chuck.



- b. Tapered--Have self-holding tapers.
 - (1) Morse taper--No. 1 to No. 5 tapers that fit directly into drill press spindle.
 - (2) Tang--Is on tapered shank which fits into the spindle slot so that the twist drill turns with the spindle.
 - (3) Tapered sleeve--A device to adapt different sizes of drill shanks.



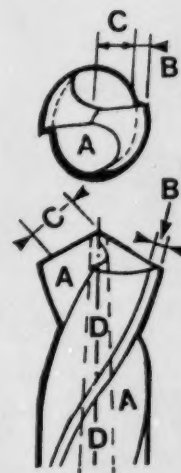
INFORMATION

3. Body--Portion between point and the shank.
Consists of:



- a. Flutes--Spiral grooves running the length of drill body.

- (1) Help form cutting edge.
- (2) Curl chips tightly for easy removal.
- (3) Form channels for chip removal.
- (4) Allow coolants and lubricants to flow to cutting edge.



- b. Margin--Narrow strip extending back length of drill to form the full diameter of the drill bit.
- c. Body clearance--The reduced part that cuts down friction between wall of hole and drill.
- d. Web--Metal column that separates the flutes, increases thickness toward the shank to give strength.

B. Types of drills

1. Carbon steel drill--Used for soft materials. Carbon drills are not usually marked on the shank.

(NOTE: Most charts for cutting RPM of twist drills are for high-speed drills. Reduce RPM one-half for carbon drills.)

2. High-speed steel--Used for hard materials. High-speed drills have "HS" or "High Speed" stamped on the shank.

C. Sizes of drills

(NOTE: Drill size charts show drill diameters in numbers, letters, fractions, and metric sizes.)

1. Number--From #80 to #1.

(NOTE: 0.135 in. to 0.2280 in. diameters)

2. Letters--A to Z. The size of lettered drills start where numbered drills end.

(NOTE: -.234 in. to 0.413 in. diameters)

3. Fractions--1/64 to 63/64 in. diameters.

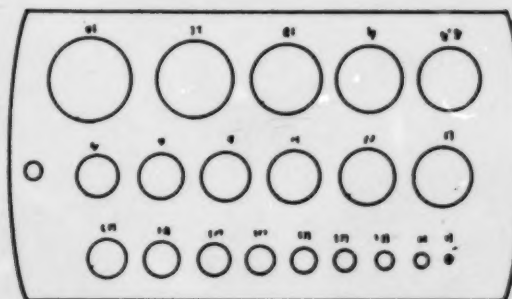
4. Metric--3mm to 76mm.

(NOTE: 0.1181 to 2.9921 in. diameters)

5. Twist drill gages are used to check the sizes of drill bits.

(NOTE: Gages are available in numbers, letters, fractions, and metric sizes.)

6. A micrometer may be used for measuring; the measurement is made across the drill margins. However, if the drill is worn, the measurement is made on the shank at the end of the flute.

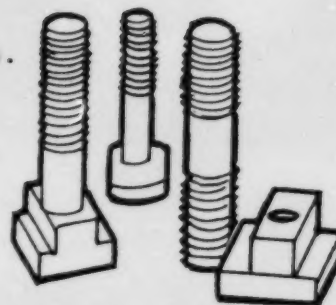


3. T-slot bolts--Fit into table slots.

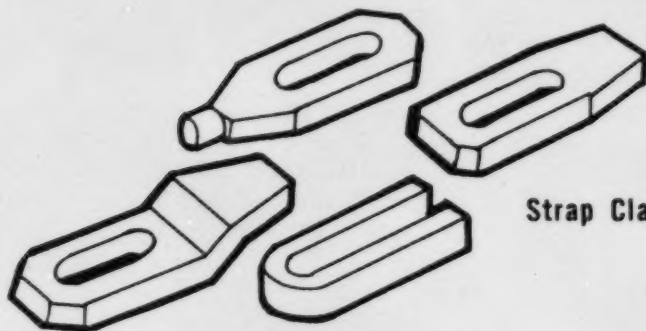
- a. Used with washer and nut.
- b. Come in various lengths.

4. Strap-clamps--Used for clamping unevenly shaped parts.

- a. Come in various lengths.
- b. Used with T-bolts.



T-Slot Bolts

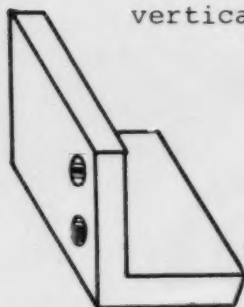
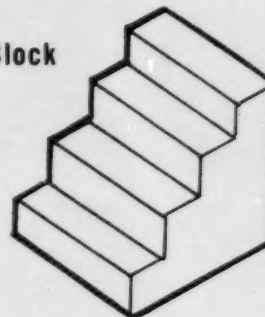


Strap Clamps

5. Step-blocks--Support strap clamps opposite the work at any level.

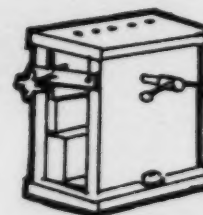
6. Angle plate--Used where work needs to be clamped to a vertical support.

Step Block



Angle Plate

Drill Jig



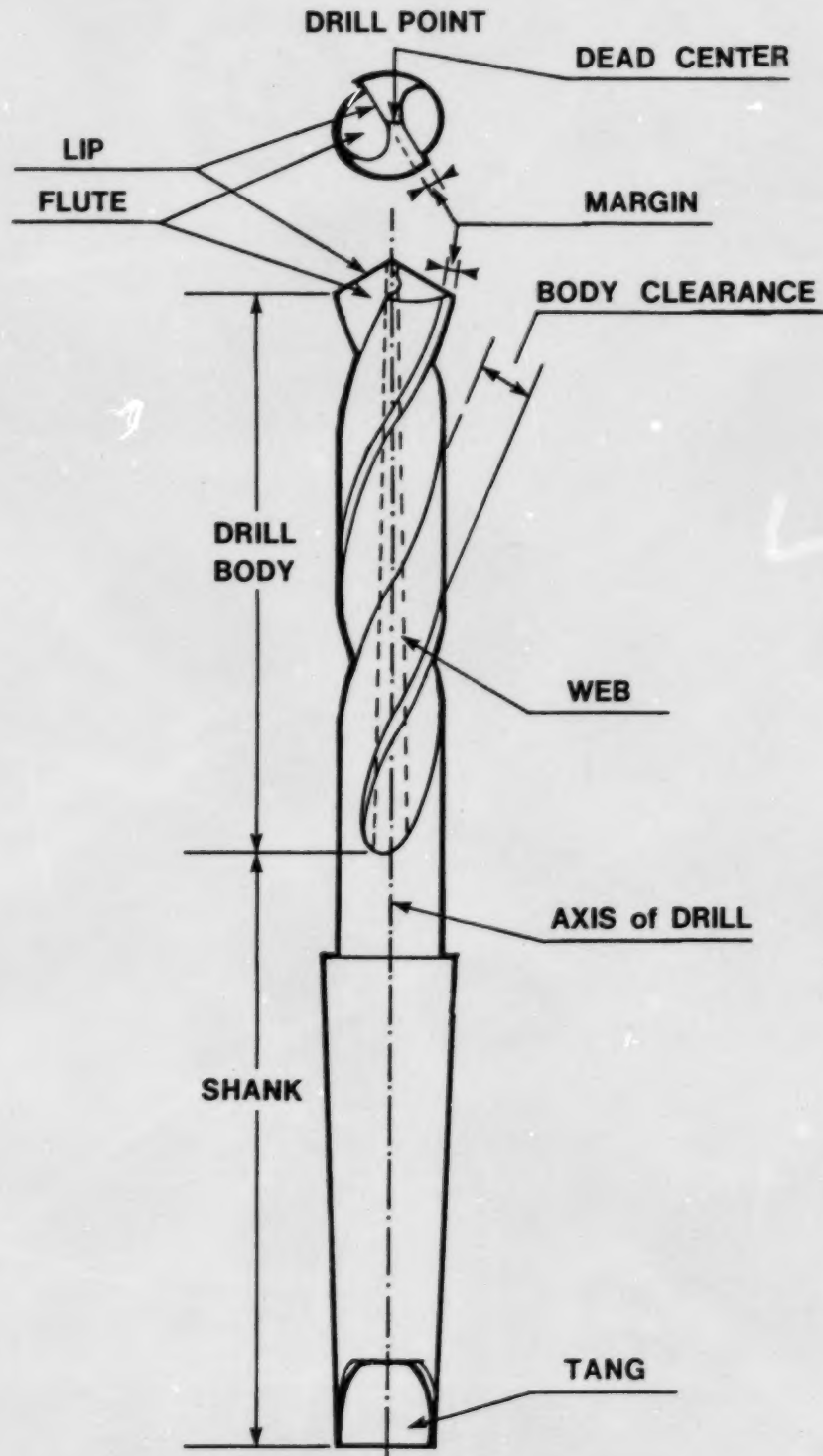
7. Drill jigs--Used when holes are to be drilled in a number of identical pieces.

8. C-clamps--Used for clamping flat stock.



C-Clamp

PARTS of a TWIST DRILL



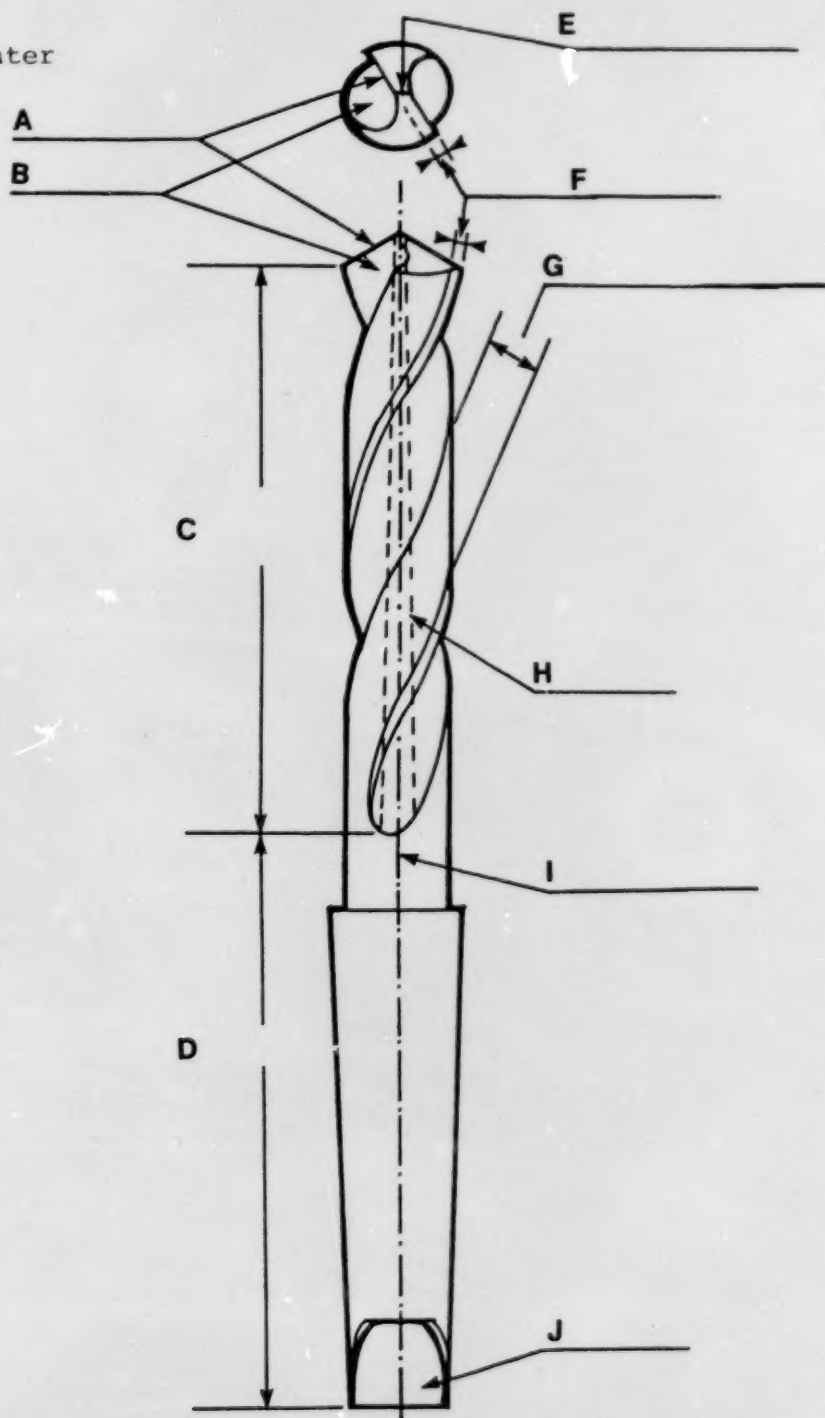
DRILL PRESS OPERATOR

ASSIGNMENT SHEET 5--IDENTIFY THE PARTS OF A DRILL

Directions: Identify the drill parts and place the correct answers by each letter provided.

lip
margin
dead center
flute
web

axis
shank
drill body
tang
body clearance



ASSIGNMENT

DRILL PRESS OPERATOR

ASSIGNMENT SHEET 6--IDENTIFY DRILLING ACCESSORIES

Directions: Match the correct word or words in the right-hand column to the definition given in the left-hand column. Place the correct number in the space provided on the left.

- | | |
|---|------------------------------|
| ___ A. To hold work in place solidly during operations. | 1. C-clamp |
| ___ B. Most commonly used holding device. | 2. drill jigs |
| ___ C. Hardened stock to raise work in vise. | 3. step blocks |
| ___ D. Used for supporting round work. | 4. vise |
| ___ E. Fit in worktable slots. | 5. purpose of holding device |
| ___ F. Use with T-bolts. | 6. angle block |
| ___ G. Supports strap clamps opposite the work. | 7. parallels |
| ___ H. Used where work needs to be clamped to a vertical support. | 8. strap clamps |
| ___ I. Used when holes are drilled in a number of identical places. | 9. V-blocks |
| ___ J. Used for clamping flat stock. | 10. T-bolts |

ASSIGNMENT

DRILL PRESS OPERATOR

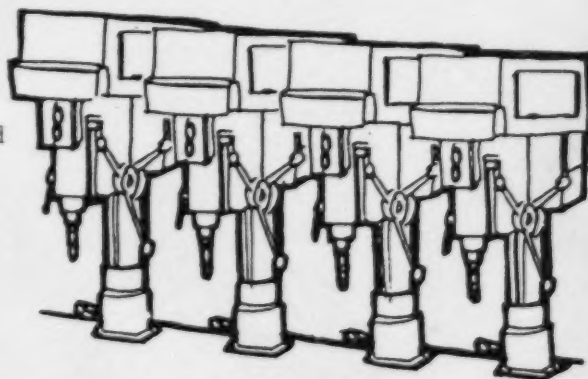
INFORMATION SHEET 4--DRILLING OPERATIONS

I. Operations performed on the drill press.

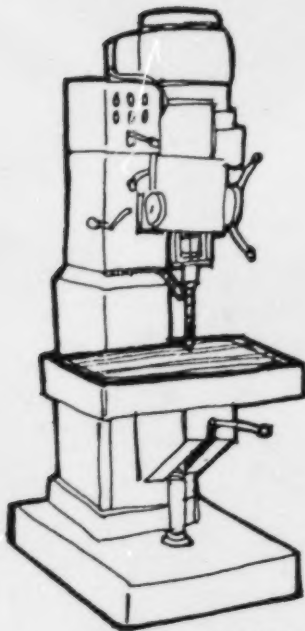
- A. Drilling--To produce a hole in metal with a drill bit.
- B. Countersinking--To shape a drilled hole in material with a cone-shaped tool to provide a recess for a flat head screw or bolt.
- C. Counterboring--To drill a second larger hole to a specified depth, using the same center as the original hole.
(NOTE: This is done to set socket head screws below the work surface.)
- D. Tapping--Is done with hand tap and wrench to cut internal threads in holes.
(NOTE: A 60° center is chucked in the drill press for alignment.)
- E. Spot-facing--Making circular spots on uneven surfaces to produce a finished flat surface for a head of a bolt or nut.
(NOTE: A counterbore is usually used.)
- F. Boring--To make a hole larger, using a single-pointed cutting tool.
- G. Spot finishing--A means of polishing and finishing surfaces with numerous circular marks, using a wood dowel and grinding compound.
- H. Reaming--Used to finish a drilled hole to an accurate size.

II. Other drilling machines

- A. Gang drill--A drilling machine with several drilling spindles fastened in line to a single long table. Is used in mass production in doing a series of operations, one after the other. One operation may often require several different drill sizes. May have two or more spindles, with 8-10 spindles quite common.

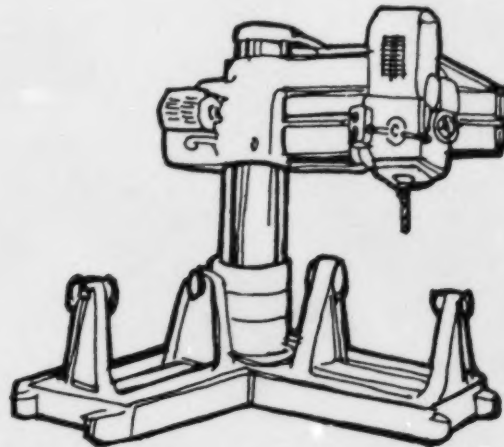


GANG



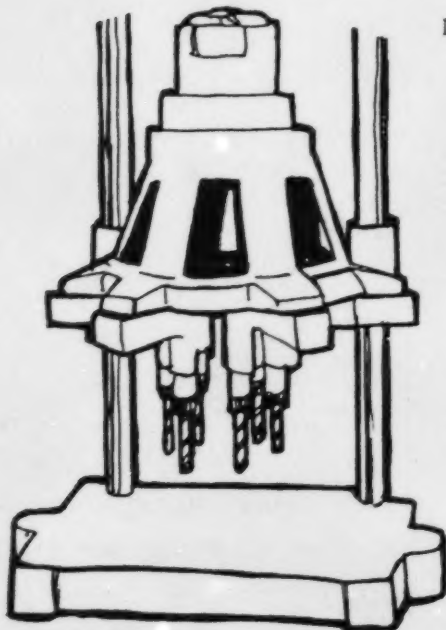
UPRIGHT

- B. Upright drill--Similar to floor-type drill press used in medium heavy-duty drilling. It usually has a gear-driven mechanism for different spindle speeds and an automatic or power feed device. It will receive larger drills and cutters than the standard bench and floor-type drill presses.



RADIAL

- C. Radial drilling machine-- Handles large workpieces that cannot be moved easily. It has a large arm extending out from the column which can be raised or lowered, and which also swings in a complete circle around the column. The drilling head moves back and forth on this arm.

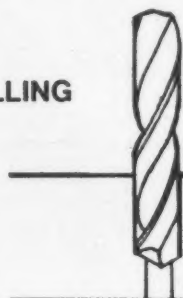


MULTI-SPINDLE

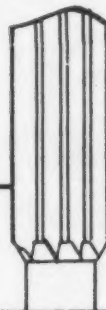
- D. Multiple-spindle drill head machine-- May have from four to 48 or more spindles which are driven by one gear drive in the head. These are mass-production drilling machines. Some have several drill heads, with many spindles making it possible to drill as many as 100 holes at one time.

OPERATIONS of the DRILL PRESS

DRILLING



REAMING



BORING



COUNTERBORING



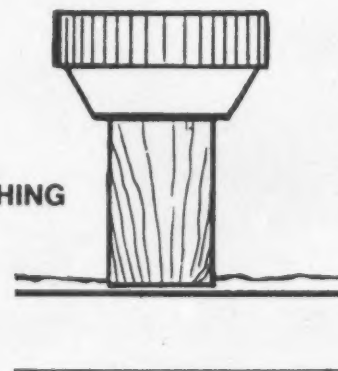
COUNTERSINKING



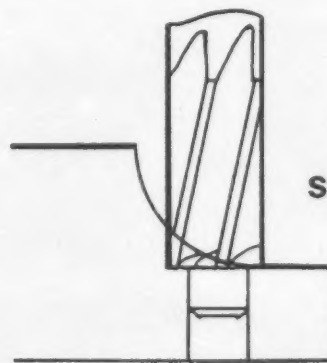
TAPPING



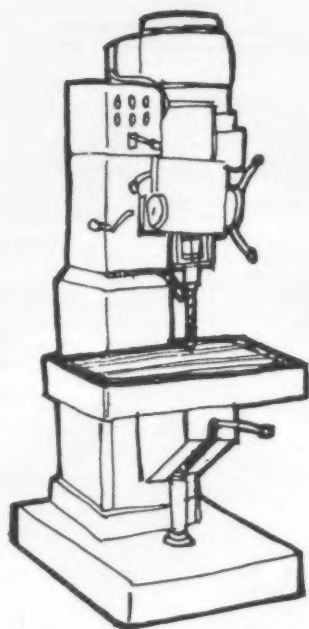
SPOTFINISHING



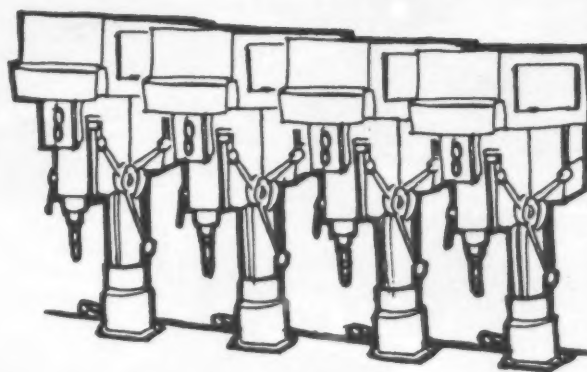
SPOTFACING



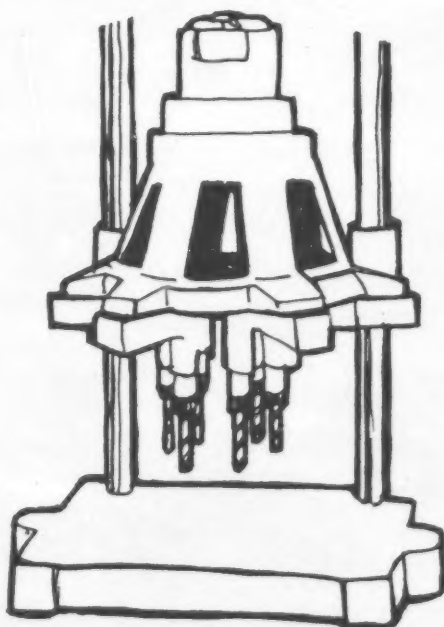
OTHER DRILLING MACHINES



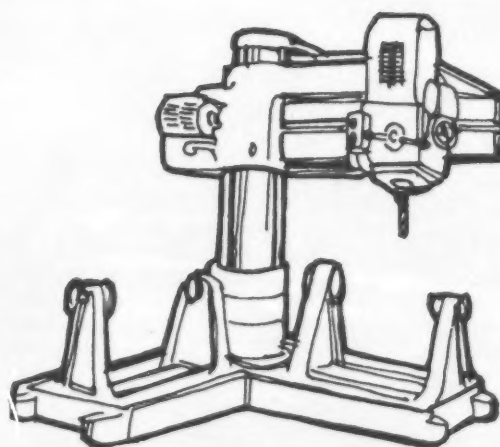
UPRIGHT



GANG



MULTI-SPINDLE



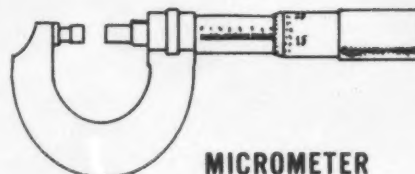
RADIAL

DRILL PRESS OPERATOR

INFORMATION SHEET 5--BASIC HAND AND POWER TOOLS

I. Hand tools

- A. Outside micrometer caliper--used to measure outside diameters and thicknesses of material, parts, etc. Generally reads to the nearest one-thousandths ($1/1000$ or 0.001).



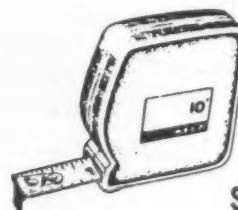
MICROMETER



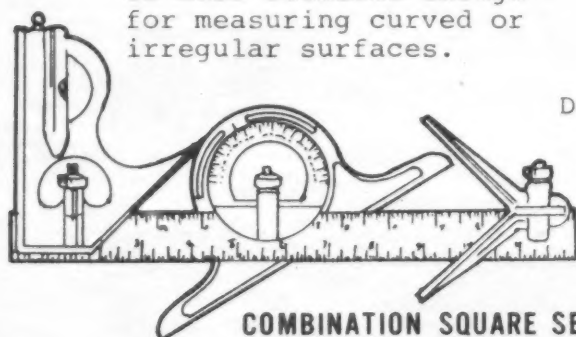
24" RULE

- B. Steel rule or bench rule--used to lay off short measurements or to make straight lines. This rule is usually 24" long and is used for bench work only, since it cannot be carried in the pocket.

- C. Steel pocket tape--available in different lengths, the steel blade is rigid enough for measuring straight surfaces, but it is also flexible enough for measuring curved or irregular surfaces.



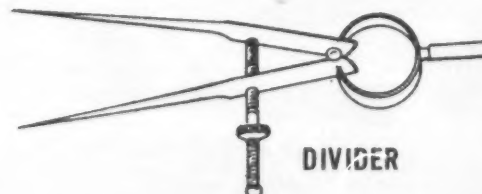
STEEL TAPE



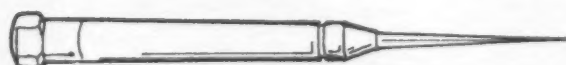
COMBINATION SQUARE SET

- D. Combination square set--adaptable to a large variety of operations in the shop. The complete combination set consists of a hardened blade, square head, center head and a bevel protractor.

- E. Divider--used for laying out circles, parts of circles and for stepping off equal measurements. It is essential that both legs of the tool be equal in length and kept pointed.



DIVIDER



SCRIBE

- F. Scribe--used to scribe or to scratch fine lines in a metal layout when accuracy is very critical. The point is made of hardened steel and kept needle sharp by frequent honing on a fine oilstone. CAUTION: Never carry an open scribe in your pocket.

- G. Prick punch--used first to mark the point where the centerlines intersect because of its sharp point.



PRICK PUNCH



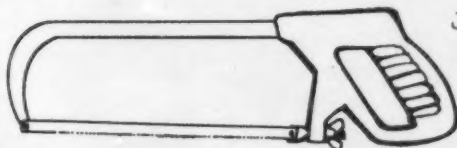
CENTER PUNCH

- H. Center punch--used after the prick punch mark has been checked and found on center to enlarge the mark for drilling holes in metal.

- I. File--used to remove considerable metal, produce a smooth surface for layout work and produce keen edges on tools. CAUTION: Never use a file without a handle. It is too easy to drive the unprotected tang into your hand.



FILE



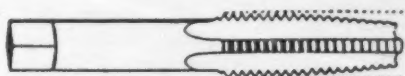
HACKSAW

- J. Hacksaw--used for cutting metal by hand. The frame is usually adjustable to different length blades.

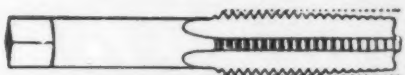
- K. Pipe cutter--used to cut pipe. By turning the "T" handle the roller forces the pipe against the cutting wheel. Too much pressure exerted on the handle may cause the cutting wheel to be broken. Cutting oil should be applied at the point where the pipe is to be cut.



PIPE CUTTER



TAPER



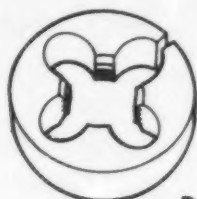
PLUG



BOTTOMING

- L. Tap--used to cut internal female threads. There are three basic types of standard hand taps: taper--for starting the thread; plug--for continuing the thread after the taper tap has cut as far into the hole as it can; bottoming--for continuing the threads to the bottom of the hole.

- M. Die--used to cut external (male) threads. There are two basic types of dies: solid and adjustable



DIE

II. Power tools

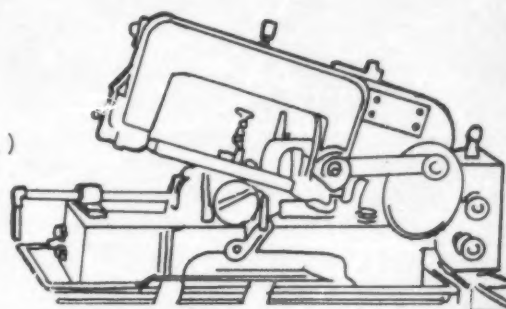
- A. Electric hand drill--portable power tool for drilling holes. Portable electric hand drills are available in the following sizes: 1/4", 3/8", 1/2", 3/4", and 1".

(NOTE: Drilling with 3/4" and 1" bits in a portable electric drill is not advised.)

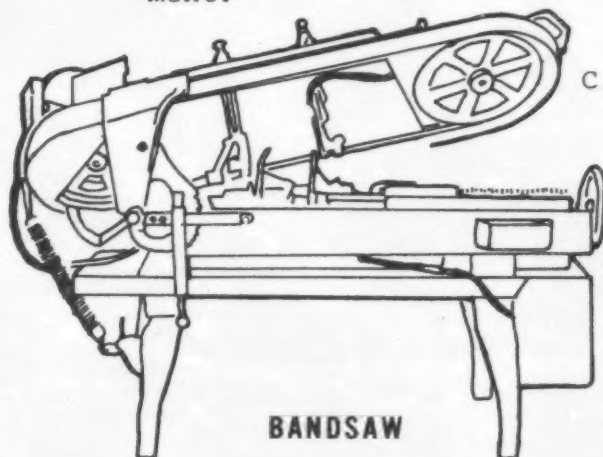


DRILL

- B. Power hacksaw--used for cutting off metal stock to length using a reciprocating (back and forth like a hand hacksaw) movement.



POWER HACKSAW



BANDSAW

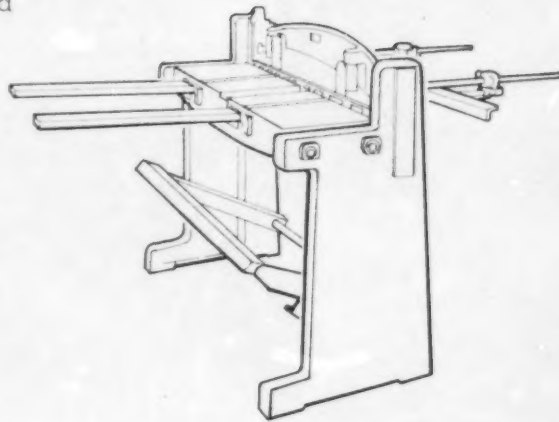
- C. Bandsaw--a machine having a continuous saw blade running on and driven by suitable pulleys and used for cutting stock to length.

- D. Portable disk grinder/sander--portable electric grinder commonly used in the shop for rough grinding. Uses 7- and 9-inch disk grinding wheels for grinding and wire cup brushes for removal of paint, rust scale, and slag from welds.



DISK GRINDER

- E. Squaring shear--stationary foot-operated shear used for squaring or trimming large sheets of metal. The maximum thickness the machine will cut is stamped on the manufacturer's specification plate on the front of the shear. May also be hydraulically or air powered.



SQUARING SHEAR

DRILL PRESS OPERATOR

ASSIGNMENT SHEET 7--BASIC HAND AND POWER TOOLS

Directions: Match the correct word or words in the right-hand column to the definition in the left-hand column. Place the correct number in the space provided on the left.

- | | |
|---|--------------------------------|
| ___ A. Used for cutting metal by hand. | 1. steel pocket tape |
| ___ B. Used to enlarge the prick mark for drilling holes. | 2. divider |
| ___ C. Used to scribe or scratch fine lines in metal. | 3. prick punch |
| ___ D. Consists of a hardened blade, square head, center head, and a bevel protractor. | 4. tap |
| ___ E. Its blade is rigid enough for measuring straight surfaces, but flexible enough for measuring curved or irregular surfaces. | 5. bandsaw |
| ___ F. Used to measure outside diameters and thickness of material. | 6. steel rule or bench rule |
| ___ G. This rule is usually 24" long and is used for bench work only. | 7. center punch |
| ___ H. Used for layout out circles. | 8. combination square set |
| ___ I. Used first to mark the point where the center lines intersect because of its sharp point. | 9. squaring shear |
| ___ J. A machine having a continuous saw blade running on and driven by suitable pulleys. | 10. outside micrometer caliper |
| ___ K. Used for cutting pipe when pressure is put on the roller and cutting well. | 11. pipe cutter |
| ___ L. Stationary foot, hydraulically or air operated machine used for squaring or trimming large sheets of metal. | 12. power hacksaw |
| ___ M. Used to remove considerable metal, produce a smooth surface for layout work and produce keen edges on tools. | 13. file |
| ___ N. Used for cutting external (male) threads. | 14. power disk sander/grinder |
| ___ O. Uses 7- or 9-inch disk grinding wheels for grinding and wire cup brushes for removal of paint, rust scale and slag from welds. | 15. scribe |
| ___ P. Used for cutting internal (female) threads. | 16. electric hand drill |
| ___ Q. Used for cutting off metal stock to length using a reciprocating (back and forth) movement. | 17. hacksaw |
| ___ R. Portable power tool for drilling holes. | 18. die |

ASSIGNMENT

DRILL PRESS OPERATOR

TEST PART 1

1. Match the terms associated with drills and drilling to the correct definition. Place the number of each term on the right in the correct blank on the left.

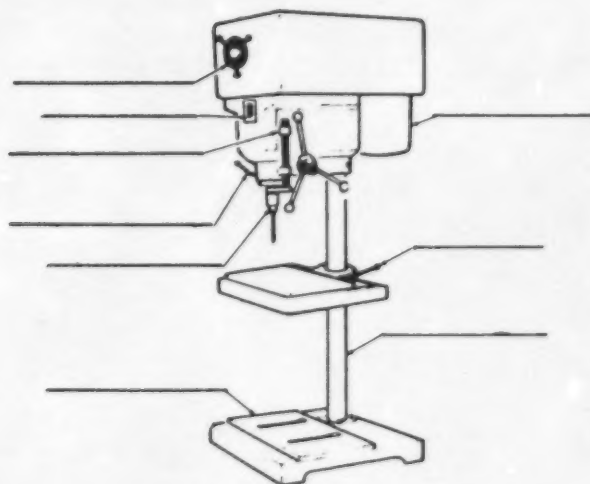
- | | |
|---|---------------------|
| ___ a. The jobs performed. | 1. Drilling |
| ___ b. Used to fasten work pieces to the table. | 2. Twist drill |
| ___ c. Forming a hole with a drill. | 3. Drill press |
| ___ d. A machine used for drilling holes in different materials. | 4. Clamping devices |
| ___ e. The cutting tool used in a drill press for drilling holes. | 5. Operations |

2. Name the two types of common shop drill presses.

- a.
b.

3. Identify the parts of a drill press by labeling the illustration below.

Chuck
Base
Table clamp lever
Column
Power assembly
Switch
Speed adjustment handwheel
Depth gauge
Spindle lock clamp



DRILL PRESS OPERATOR

TEST PART 2

1. Explain the use of cutting speeds and feeds by circling the word or words that best completes each sentence below.
 - a. The surface speed that the drill rotates is called the
 1. feed.
 2. cutting speed.
 3. RPM.
 - b. The cutting speed of a drill is shown in
 1. revolutions per minute.
 2. inches.
 3. feet per minute.
 - c. The speed at which a cutter is forced into the work with each revolution is the
 1. operation.
 2. feed.
 3. drilling ability.
 - d. The speed and feed tables provide the drill operator with information about
 1. the length of the drill bit.
 2. the size of the drill press.
 3. the recommended feed and speed for drilling various types of metal.
 - e. Correct feed of a properly sharpened drill bit into the work will most likely make
 1. uniform chips.
 2. chatter.
 3. chipped cutting edges on the drill.
 - f. The proper formula for figuring RPM of a drill when you do not have a table is
 1. $RPM = \frac{4 \times D}{CS}$
 2. $RPM = \frac{4 \times \text{length of drill}}{CS}$
 3. $RPM = \frac{4 \times CS}{D}$

- g. The abbreviation CS stands for
 - 1. cutting speed.
 - 2. diameter of the drill
 - 3. cutting surface
 - h. The RPM used for drilling a 1-inch hole in metal with a cutting speed of 50 surface feet per minute would be
 - 1. 100 RPM
 - 2. 200 RPM
 - 3. 300 RPM
2. List three purposes of cutting fluids.
- a.
 - b.
 - c.

DRILL PRESS OPERATOR

TEST PART 3

1. Identify the parts of the twist drill from the drawing below. Write the name of each part in the blank provided.

Flute

Dead center

Drill body

Tong

Web

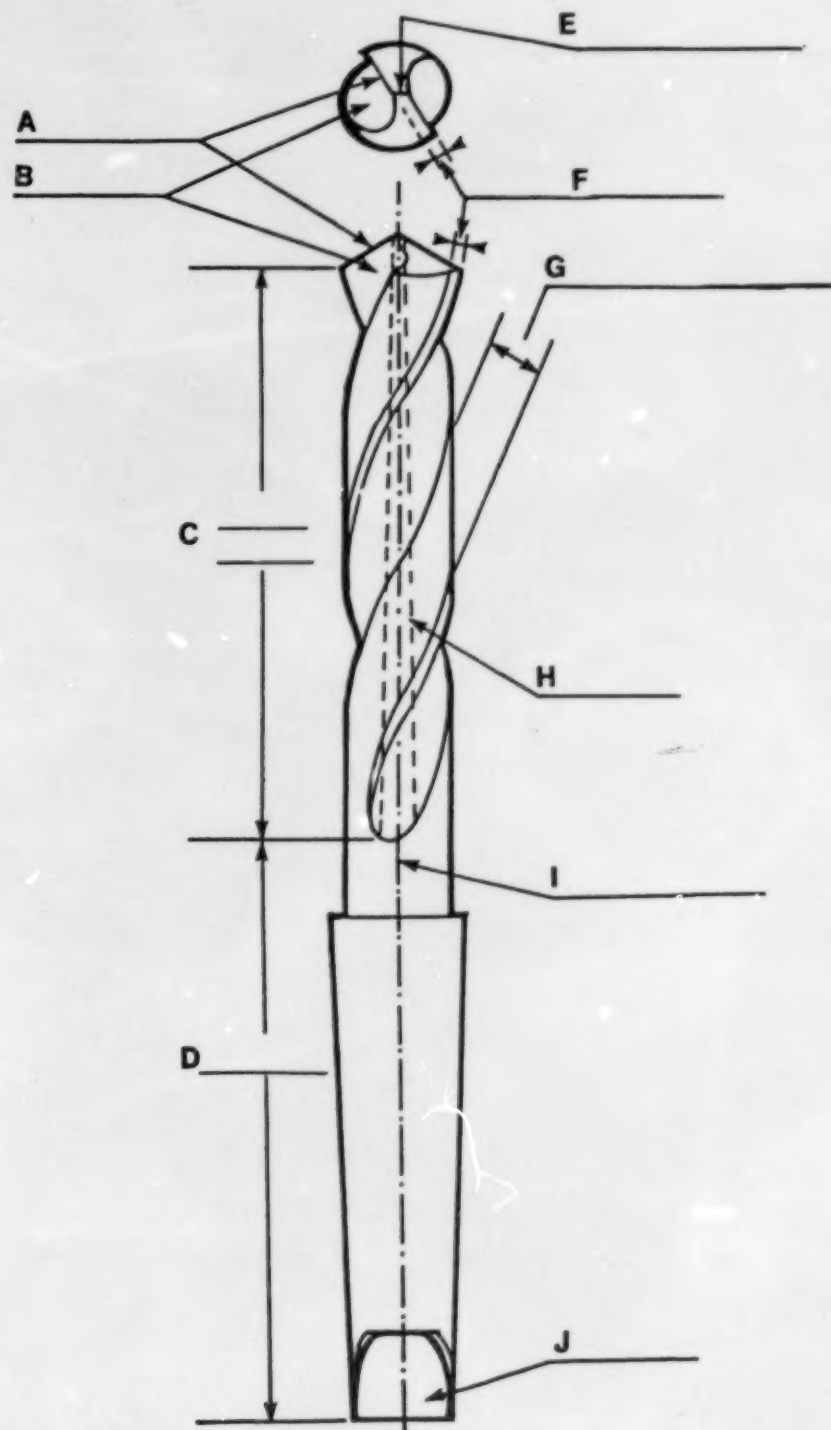
Axis

Lip

Body clearance

Margin

Shank



2. Identify the accessories used on the drill press. Write the name of each in the blanks provided.

V-block

Angle plate

T-slot bolt

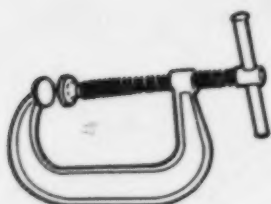
C-clamp

Strap-clamp

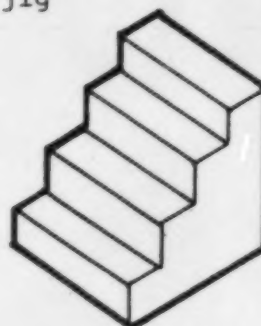
Step block

Vise

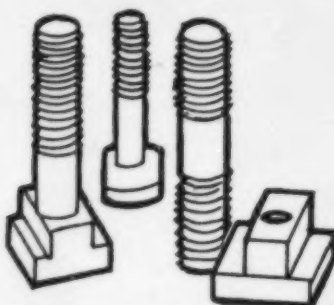
Drill jig



a. _____



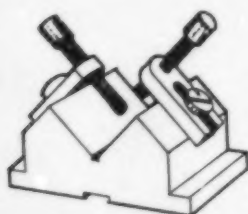
b. _____



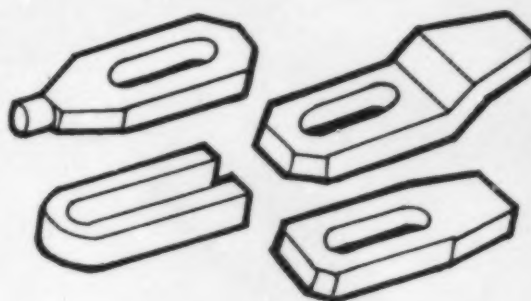
c. _____



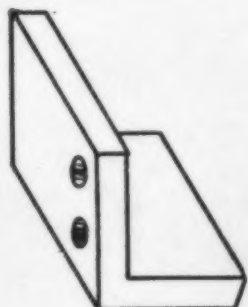
d. _____



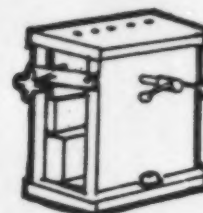
e. _____



f. _____



g. _____



h. _____

DRILL PRESS OPERATOR

TEST PART 4

1. Point out the operations that can be performed on the drill press by writing the number of each operation listed on the right in the correct blank.

- | | |
|--|-------------------|
| ___ a. To finish a drilled hole to an accurate size. | 1. Boring |
| ___ b. To make a hole larger with a single-pointed cutting tool. | 2. Drilling |
| ___ c. To cut internal threads in a hole. | 3. Tapping |
| ___ d. To finish and polish surfaces with numerous circular marks. | 4. Spot finishing |
| ___ e. To produce a hole in metal with a drill bit. | 5. Reaming |
| ___ f. To shape the opening of a drilled hole with a cone-shaped tool to provide a recess for a flat head screw. | 6. Counterboring |
| ___ g. To drill a second larger hole to a specified depth, using the same center as the first hole. | 7. Countersinking |

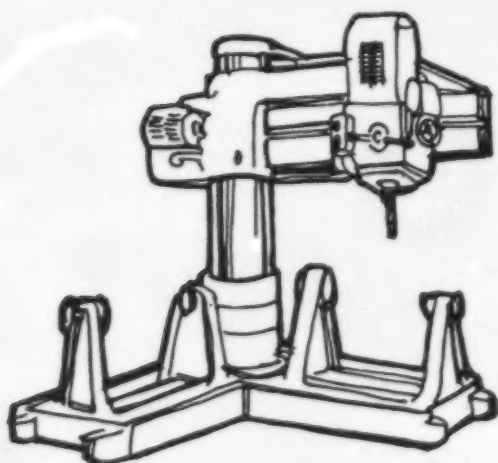
2. Identify the other drilling machines used in industry by labeling each picture.

Upright

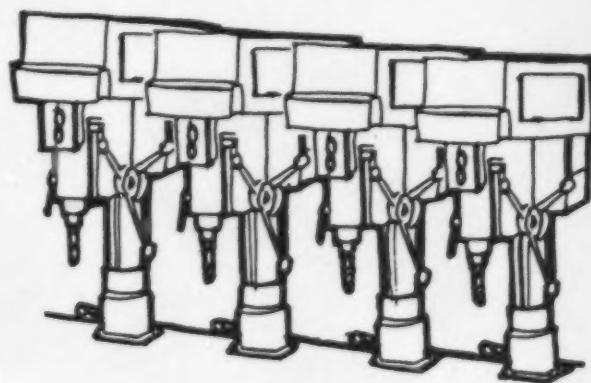
Gang

Multispindle

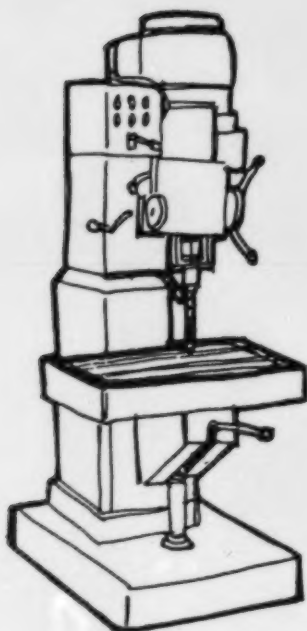
Radial



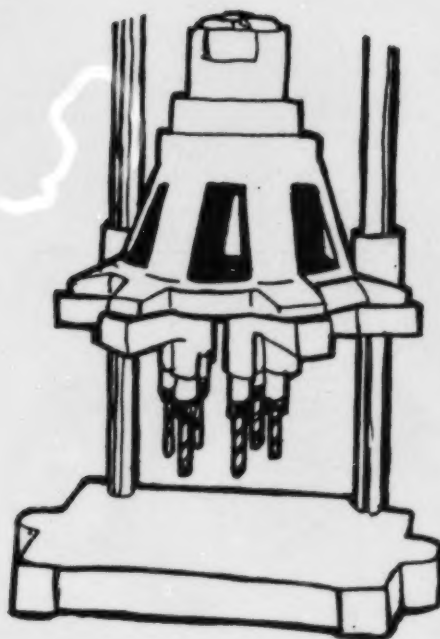
a. _____



b. _____



c. _____



d. _____

DRILL PRESS OPERATOR

TEST PART 5

1. Identify the hand and power tools used by the drill press operator. Write the name of each in the blank provided.

Outside micrometer caliper

Die

Tap

Steel rule or bench rule

Pipe cutter

Power hacksaw

Steel pocket tape

Combination square set

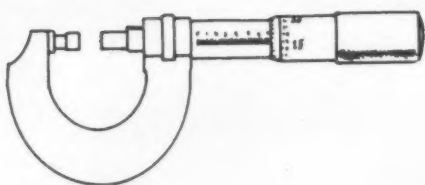
File

Divider

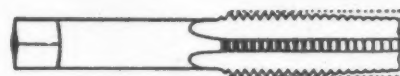
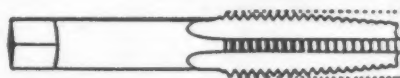
Scribe

Center punch

Prick punch



a. _____



b. _____

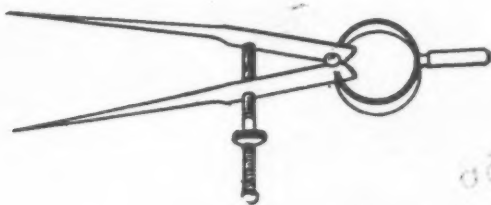
e. _____



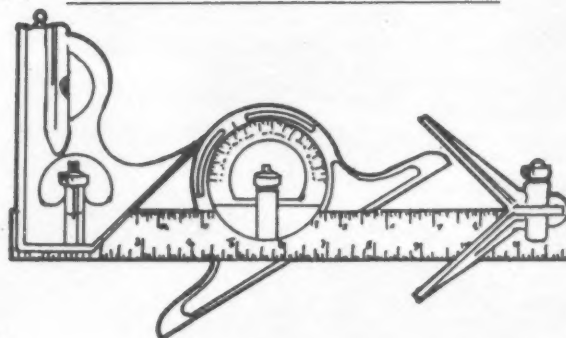
c. _____



f. _____



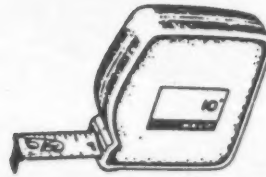
d. _____



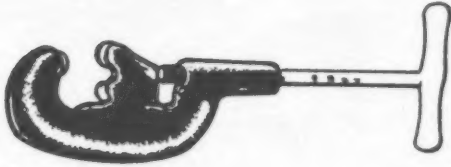
55g.



h. _____



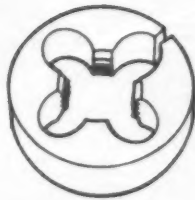
l. _____



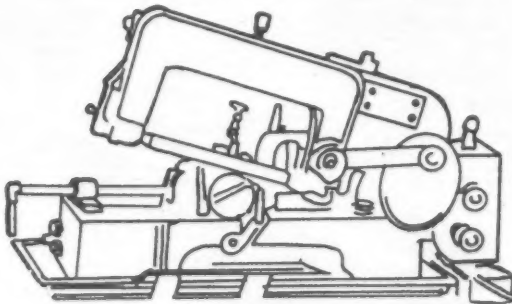
i. _____



m. _____



j. _____



k. _____